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Demographic Disparities in 5G Technology Adoption among Paddy Farmers in Kedah: A Comprehensive Study

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ABSTRACT

This research aims to investigate the adoption of 5G technology within the agricultural sector, specifically among rice farmers in Kedah, Malaysia, and understand the demographic disparities in 5G adoption. It also addresses the challenge of equitable 5G technology adoption and explores how demographic factors such as gender, age, ethnicity, and income levels influence adoption patterns. A mixed-methods approach, comprising surveys, interviews, and field observations, is employed to collect data from a diverse sample of farmers. The study utilizes theoretical frameworks related to automation, productivity, and connectivity to analyze the impact of 5G technology on agricultural practices. Only descriptive analysis of demographic characteristics will be reported after the survey is conducted using a questionnaire through the What'sApp application. The research reveals significant gender imbalances in adoption rates, with implications for equitable access to technological advancements. It also highlights the influence of age and income on adoption patterns. The study underscores the importance of tailored strategies to ensure the adoption of inclusive 5G technology in the agricultural sector.

Keywords: 5G technology adaption, agricultural sector, demographic disparities, descriptive analysis, paddy farmers

1. INTRODUCTION

Smart farming and precision agriculture rely on IoT components like sensors, drones, and robots. In agriculture, IoT means interconnected devices working in real time to gather, analyze, and share data for informed farming decisions. 4G/3G networks have limitations in real-time precision practices due to bandwidth and connectivity issues. On the other hand, 5G technology has significantly improved real-time monitoring, unmanned aerial vehicles, virtual consultations, predictive maintenance, AI robotics, and data analytics. It overcomes limitations, providing faster speeds, better connectivity, scalability, and processing power and addressing previous constraints in agriculture [1].

The Malaysian Ministry of Agriculture encouraged farmers to explore precision farming for improved rice production through IoT adoption, like drones for fertilization and pest control. However, traditional farmers, often with limited resources, are less involved in precision farming despite the potential benefits seen in other countries. Farmers recognize their role in promoting sustainable consumption and production patterns in the evolving agricultural landscape [2]. To keep up with technological advancements, 5G technology, offering high speed, low latency, and broad connectivity, holds great promise for revolutionizing agriculture.

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Traditional agriculture methods are evolving into smart farming for increased crop yields and reduced human involvement. Smart farming relies on components like sensors that collect and transmit large amounts of data in real-time. 5G technology plays a vital role in smart farming, predicting and preventing crop diseases through mobile phones. It offers numerous applications in agriculture, including unmanned aerial vehicles, real-time monitoring, climate change mitigation, visual surveillance, predictive measures, AI-powered robotics, and data analytics with cloud storage [1].

In 2019, e-PADI, an IoT-based system for monitoring paddy productivity, was successfully designed and tested, utilizing microcontrollers and sensor nodes to track paddy development [3]. Paddy farming is a vital component of Kedah's agricultural landscape. The state of Kedah, located in Malaysia, is renowned for its agricultural industry, with paddy cultivation being a significant contributor to the local economy [4]. The adoption of modern technologies, including 5G, in paddy farming could potentially transform the sector by improving production, resource management, and decision-making.

This study focuses on the impact of 5G technology adoption in the agricultural industry, specifically among individuals aged 20 to 60 years and above, reflecting high-tech users in the modern era. It examines how and why the agricultural sector continues to embrace 5G technology. This research contributes to a deeper understanding of 5G technology, particularly its utilization in the agricultural industry [5]. It sheds light on how farmers harness automation and robotics in the context of 5G technology. Moreover, it identifies opportunities for new and expanding businesses within agriculture, highlighting 5G's potential to enhance farmers' livelihoods. By leveraging 5G technology, the agricultural industry can optimize essential processes like fertilization and harvesting. Ultimately, this study aids in improving the quality of life resources, promoting a sustainable and technology-driven agricultural future.

2. LITERATURE REVIEW

5G is a revolutionary development in network technologies that is gradually becoming very common among people, contributing significantly in different fields such as education, industry, agriculture, health, tourism, and the military. Currently, 5G is an outbreak change as opposed to the traditional internet service since it offers better quality, ultra-fast connection, low cost, reduced latency, and energy saving, which makes its great impact even greater in people's lives [6].

However, previous studies have revealed limited research on the comprehensive impact of 5G technology on the agriculture sector in Kedah. While some studies have explored specific aspects of 5G technology in agriculture, such as precision farming [7], a holistic understanding of its effects on Kedah's unique agricultural landscape is still lacking. This research gap underscores the need for a specific study in Kedah to examine the potential benefits, challenges, and strategies for the successful integration of 5G technology into agricultural practices [8].

Despite the potential advantages of 5G technology in agriculture, there is a lack of comprehensive research on its overall impact on Kedah's agricultural sector [2]. While various studies [1],[6], [7], [8] have highlighted specific applications or components of 5G technology in agriculture, such as precision farming; there remains a dearth of research that systematically examines its effects on all facets of the agricultural economy in Kedah. This knowledge gap hampers informed decision-making for policymakers, farmers, and technology providers.

Paddy farming has long been a cornerstone of Kedah's agricultural landscape, making it a vital contributor to the state's economy and food security. Paddy, or rice, is a staple crop in Malaysia, and Kedah has consistently been a significant contributor to the nation's rice production. The

state's fertile land and favorable climatic conditions have made it an ideal region for paddy cultivation. Historically, Kedah has played a crucial role in meeting the nation's rice demands, and understanding the state's status as a paddy farming hub is essential for comprehending the impact of 5G technology in this context [2].

The findings suggest that 5G may help promote internet service usage more effectively with its low cost, faster data transfer, and better quality. Moreover, the findings indicate a positive effect of gender as a mediator between the variables: Perceived Skills Readiness, Perceived Ease of use, and Perceived Resources [9].

While existing studies shed light on the potential advantages and applications of 5G technology in agriculture, a dedicated study focusing on Kedah's agricultural sector is warranted. Kedah's unique characteristics, challenges, and significance in Malaysia's rice production make it an ideal candidate for in-depth research. Policymakers, farmers, and technology providers in Kedah stand to benefit from a comprehensive study that explores the potential advantages, challenges, and strategies for successful 5G technology integration into local agricultural operations. Such research will provide insights into the specific needs and opportunities within Kedah's paddy farming landscape [2].

In conclusion, Kedah's paddy farming sector holds a significant position in Malaysia's agricultural landscape, and precision farming, aided by 5G technology, can further enhance its productivity and sustainability. By examining the potential applications and challenges of 5G technology in Kedah's context, this study aims to contribute valuable insights for policymakers, farmers, and stakeholders in the region. Understanding how 5G technology can reshape.

3. RESEARCH METHOD

3.1 Research Design – Quantitative Approach, Tool Distribution and Data Collection

The principal objective of our study is to assess the level of interest among residents of Kedah in engaging with the agricultural sector following the adoption of 5G technology. To accomplish this, we have employed a questionnaire-based data collection methodology, drawing from the guidance of Roopa and Satya [10], who emphasize the prominence of questionnaires as a conventional approach for gathering primary quantitative data. Questionnaires provide the advantage of consistently acquiring quantitative data, ensuring internal coherence for subsequent analysis. Essentially, a questionnaire comprises a set of written questions that necessitate responses from the participants.

Our questionnaire encompasses a blend of open-ended and closed-ended questions, with closed-ended questions allowing respondents to delve deeper into their perspectives. By incorporating various question types, our questionnaire serves both the qualitative and quantitative facets of market research. In its entirety, the questionnaire consists of 20 questions, excluding demographic queries, and employs a Likert scale ranging from 1 to 5 for rating. This five-point Likert scale is advantageous over the four-point scale as it accommodates respondents who may adopt a neutral or undecided stance on a given topic, offering a more nuanced perspective.

During the data collection phase, the questionnaires were distributed to 300 snowballing selected individuals residing in Kedah. The survey was disseminated across various platforms, including WhatsApp and in-person visits to villages and agricultural agencies. This streamlined distribution approach is purposefully designed to optimize response rates and streamline the data collection, thus saving valuable time.

3.2 Population, Sampling and Unit of Analysis

This study focuses on paddy farmers residing in Kedah state who have a keen interest in 5G technology. To achieve this, a specific subset of the broader population of paddy farmers in Kedah was selected for survey participation, following the methodology suggested by Salant and Dillman [11]. The unit of analysis in our research was comprised of paddy farmers in Kedah who not only reside in the region but also possess awareness regarding the advantages of applying 5G technology in agriculture. A total of 300 paddy farmers from Kedah actively engaged in this study and responded to the survey.

3.3 Frequency as Descriptive Analysis

The process of data analysis serves three primary objectives: obtaining a comprehensive overview of the sample data and its characteristics, to verify the accuracy and reliability of the collected data, as accurate data forms the foundation of any meaningful analysis, and finally to confirm whether the research goals and hypotheses are substantiated by the data.

To facilitate these objectives, a descriptive statistical method known as frequency analysis is employed, as suggested by Loeb et al. [12]. This technique provides insights into the frequency of each response selected by respondents. For a more in-depth analysis and to assist researchers in deriving meaningful conclusions, the Statistical Package for the Social Sciences version 27 (SPSS 27) is utilized. SPSS 27 computes essential statistical measures such as the mean, median, and mode when conducting frequency analysis. Additionally, tables and charts are employed to summarize the demographic characteristics of the study's findings, providing a visual representation of the data for better comprehension.

4. RESULTS AND DISCUSSION

4.1 Response Rate

The questionnaires were disseminated to participants using a snowball sampling approach, primarily through dedicated WhatsApp groups associated with paddy farmers. Subsequently, the findings unveiled that a total of 300 participants actively responded to the questionnaires within a one-month timeframe. The noteworthy aspect is that each participant completed the survey, indicating remarkably high participation rates. Regarding the response rate, which serves as a metric indicating the proportion of distributed questionnaires that were effectively returned, it is imperative to note that this survey achieved an outstanding response rate of 100%. Such a response rate is widely considered optimal and is often associated with well-designed surveys and a high degree of participant engagement.

4.2 A Descriptive Analysis of Demographic Characteristics

4.2.1 Gender

The finding presented in Figure 1 pertains to the distribution of respondents based on gender, with the two categories being male and female. The data reveals that out of the total respondents, 162 individuals (54%) identified as male, while 138 individuals (45%) identified as female.

The key observation here is that a higher percentage of male respondents participated in the study compared to female respondents. Specifically, 54% of the respondents are male, while only 45% are female. This gender imbalance within the study sample raises important considerations when analyzing and interpreting the data.

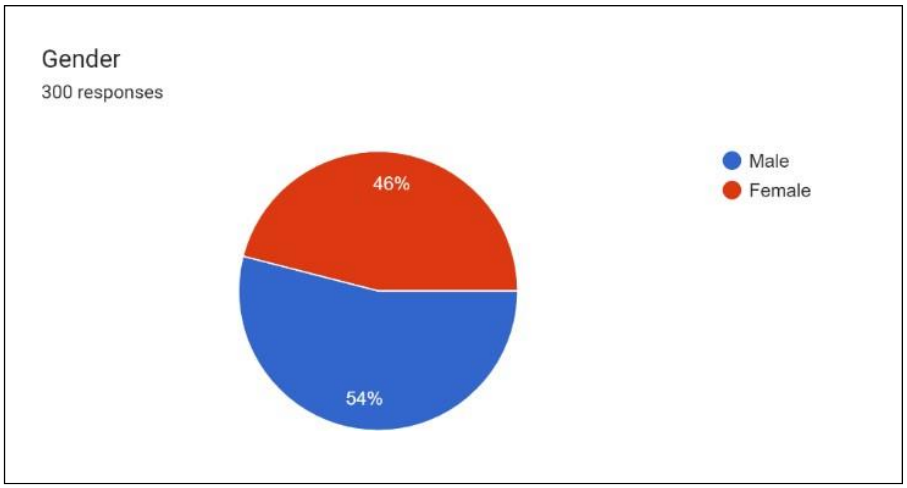

Figure 1: Gender of Respondents.

Gender Disparity: The fact that there is a notable difference in the number of male and female respondents suggests that the study may not have achieved a balanced representation of both genders. This gender disparity could potentially impact the study's findings, especially if the research topic is related to gender-related issues or if gender plays a significant role in the variables under investigation.

Potential Bias: A skewed gender distribution can introduce bias into the results. If the experiences, perspectives, or attitudes of male and female respondents differ significantly, this bias can affect the overall conclusions drawn from the study. Researchers should be cautious when generalizing findings, as they may primarily reflect the views of one gender more than the other.

Implications for Gender Analysis: Researchers should consider conducting subgroup analyses or examining gender-specific patterns in the data to better understand how perceptions or outcomes differ between male and female respondents. This can provide insights into whether gender-related factors influence the study's results.

Research Context: The interpretation of these findings should also consider the broader context of the study. It is essential to consider whether the gender distribution aligns with the characteristics of the population being studied and whether any recruitment or sampling biases may have contributed to the observed gender discrepancy.

In summary, the gender distribution among respondents in Figure 1 highlights a potential source of variation in the study's findings and underscores the importance of considering gender-related factors when analyzing and interpreting the data. Researchers should explore any implications of this gender disparity within the context of their research objectives, and be mindful of potential biases that may arise from uneven gender representation.

4.2.2 Age

The finding presented in Figure 2 provides insights into the distribution of respondents based on their age groups, categorizing them into four distinct brackets: 20 to 30 years old, 40 to 50 years old, 50 to 60 years old, and 60 years old and older. The data reveals the following breakdown of respondents across these age categories:

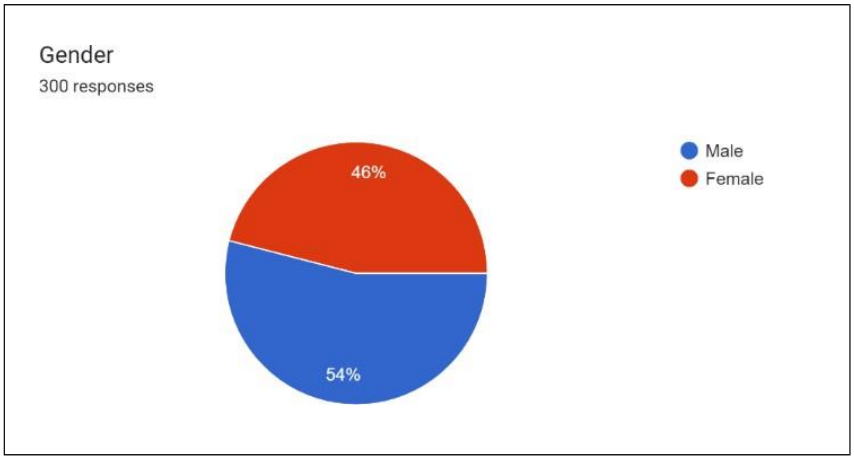

Figure 2: Age of Respondents.

Ages 20 to 30: The largest age group is comprised of 171 respondents, accounting for 57% of the total participants. This indicates a substantial presence of young adults in the study, falling within the 20 to 30 age range.

Ages 40 to 50: The second most prominent age group consists of 71 respondents, constituting 23.7% of the sample. This group falls within the 40 to 50 age range, indicating a notable representation of middle-aged individuals.

Ages 50 to 60: There are 33 respondents, making up 11% of the participants, within the 50 to 60 age brackets.

Ages 60 and Older: The final age category, comprising individuals aged 60 years and older, is represented by 25 respondents, accounting for 8.3% of the total sample.

Key points to consider when analyzing and interpreting these findings:

Age Distribution: The data highlights a predominantly young respondent population, with the 20 to 30 age group being the most substantial. This demographic skew suggests that the study may primarily reflect the views and perspectives of younger individuals.

Age-Based Insights: Researchers should explore whether age plays a significant role in the study's variables or outcomes. Age-related differences in responses may indicate generational variations in attitudes, experiences, or behaviors relevant to the research topic.

Sampling Bias: The age distribution may reflect the sampling process. If the research design or recruitment methods disproportionately targeted younger individuals, this should be acknowledged when interpreting the results.

Generalizability: The findings may have limited generalizability to older age groups or populations with different age distributions. Researchers should be cautious when extrapolating conclusions to broader demographics.

In summary, Figure 2 illustrates the age distribution of respondents, showcasing a substantial presence of young adults in the study. Researchers should carefully consider how this demographic composition may influence the study's findings and explore age-related patterns and implications within their research objectives. Additionally, transparency about the sampling process is crucial for accurately interpreting and applying these findings.

4.2.3 Races

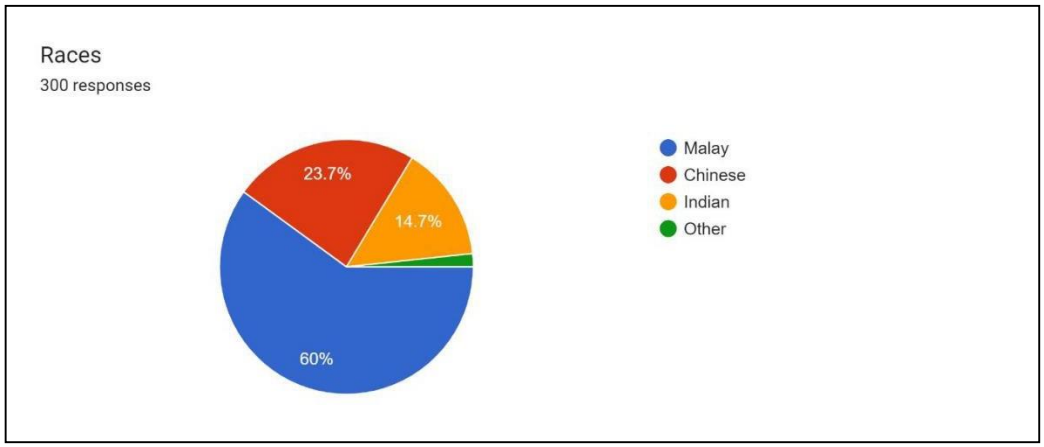

Figure 3: Races of Respondent.

The finding presented in Figure 3 provides insights into the distribution of respondents based on their ethnic backgrounds. The data categorizes respondents into four distinct ethnic groups: Malay, Chinese, Indian, and "Other." Here is a breakdown of the distribution of respondents across these ethnic categories:

Malay: The largest ethnic group among the respondents consists of approximately 180 individuals, representing 60% of the total participants. This indicates a significant presence of Malay respondents in the study, making them the majority ethnic group.

Chinese: The second most prominent ethnic group includes 71 individuals, constituting approximately 23.7% of the sample. This group identifies as Chinese.

Indian: About 44 respondents, or approximately 14.7% of the participants, identify as Indian, making them the third-largest ethnic group in the study.

Other: A smaller segment of the respondents, specifically 5 individuals or 1.75%, falls into the "Other" category, indicating a mix of ethnic backgrounds beyond the three major ethnic groups mentioned above.

Key considerations when analyzing and interpreting these findings:

Ethnic Diversity: The data reflects a diverse ethnic composition among the respondents, with Malay, Chinese, and Indian individuals contributing to the study. The presence of multiple ethnicities suggests a broader representation of perspectives and experiences.

Majority Ethnic Group: Most Malay respondents in the study could potentially influence the research outcomes. Researchers should consider whether the distribution of ethnicities aligns with the broader population they aim to study.

Cultural Context: Ethnicity often correlates with cultural factors, beliefs, and practices. Researchers should explore whether these ethnic differences have any bearing on the study's variables or outcomes, as they may offer valuable insights.

Sampling Considerations: It is important to ensure that the ethnic distribution in the study sample is reflective of the population from which it was drawn. Any sampling bias or non-representativeness should be acknowledged when interpreting and generalizing the findings.

Sensitivity: Depending on the research topic, the ethnic composition of respondents may be highly relevant. Researchers should be sensitive to cultural nuances and differences that could impact the study's results.

In summary, Figure 3 depicts the ethnic distribution of respondents, showcasing a diverse representation of Malay, Chinese, Indian, and other ethnic backgrounds. Researchers should carefully assess how this ethnic composition may influence the study's findings and should consider cultural factors and sensitivities within the context of their research objectives. Additionally, transparency about the sampling process is essential for accurately interpreting these findings.

4.2.4 Personal Income Monthly Level

Table 1. Income of Respondents.

Item	Description	Frequency	Percentage, %
Income	RM1000 and below	44	14.7
	RM1001-RM2000	72	24
	RM2001-RM3000	139	46.3
	RM3001-RM4000	28	9.3
	RM4001-RM5000	3	1
	Above RM5000	14	4.7
	Total	300	100

The finding presented in Table 1 sheds light on the distribution of respondents' monthly personal income levels. The data categorizes respondents into six distinct income brackets: RM1000 and below, RM1001 to RM2000, RM2001 to RM3000, RM3001 to RM4000, RM4001 to RM5000, and RM5000 and above. Here is an elaboration and discussion of this finding:

Income Distribution: The table reveals that respondents' monthly personal income levels are distributed across a range of income categories. These categories are designed to capture a wide spectrum of income levels, providing a comprehensive view of the respondents' financial situations.

Dominant Income Range: The most noteworthy observation is that the largest group of respondents falls within the income range of RM2001 to RM3000, with 139 individuals representing this category. This income bracket accounts for 46.3% of the total respondents. This indicates that a significant portion of the respondents earn within this specific income range.
Lowest Income Group: Another distinct group is comprised of 44 respondents (14.7%) with monthly incomes of RM1000 or below. This group represents individuals with relatively lower income levels.

Higher Income Categories: The data also shows that 72 respondents (24%) earn above RM1001 per month. These individuals are distributed across various income brackets ranging from RM1001 and above, signifying a degree of income diversity among this subset of respondents.

Key considerations when analyzing and interpreting these findings:

Income Disparities: The income distribution among respondents reflects varying income levels, with the majority situated within the middle-income range (RM2001 to RM3000). Researchers should consider whether income disparities may influence the study's results, particularly if the research topic is related to economic factors or financial behaviors.

Economic Context: Understanding respondents' income levels is crucial for contextualizing their perspectives and experiences, especially in studies examining economic issues or consumer behavior.

Sampling Implications: Researchers should ensure that the income distribution in the study sample is representative of the broader population they aim to study. Any sampling bias or skew in income representation should be acknowledged when interpreting the findings.

Impact on Research Objectives: The income distribution may have implications for the study's objectives. For example, it could be relevant in studies investigating the effect of income on certain outcomes or behaviors.

In summary, Table 1 provides a breakdown of respondents' monthly personal income levels, highlighting the distribution of income across various categories. Researchers should carefully assess how this income composition may affect the study's findings and consider income-related factors within their research objectives. Additionally, transparency about the sampling process is crucial for accurately interpreting and generalizing these findings.

5. CONCLUSION

The findings of this study not only illuminate the transformative potential of 5G technology in the agricultural sector but also provide valuable insights into the demographic composition of the respondents. These demographic insights enrich our understanding of how different population segments perceive and engage with 5G technology in the context of paddy farming in Kedah.

Gender and Age Representation: The study identifies a notable gender disparity, with a higher participation rate among male respondents compared to female respondents. Furthermore, the study highlights a significant presence of young adults, particularly those aged 20 to 30. This demographic skew suggests that the perspectives and experiences of younger individuals hold a prominent place in the study's findings.

Ethnic Diversity: The research underscores the ethnic diversity among respondents, with Malay participants forming the majority, followed by Chinese and Indian respondents. This diversity reflects a broader spectrum of cultural backgrounds and perspectives within the study.

Income Distribution: The study sheds light on the varying income levels of the respondents. The majority falls within the RM2001 to RM3000 income range, while significant representations exist in both lower and higher income categories. This income diversity paints a more comprehensive picture of the financial situations of those involved in paddy farming in Kedah.

In practical terms, these demographic findings underscore the importance of considering the nuances of gender, age, ethnicity, and income when formulating strategies for adopting 5G technology in agriculture. Tailored approaches and targeted outreach may be necessary to ensure that the benefits of 5G technology are accessible and applicable to all segments of the agricultural community.

As we navigate the intersection of technology and agriculture, it is imperative to recognize that the acceptance and impact of 5G technology may vary across demographic groups. Thus, future research and initiatives should account for these demographic factors to promote equitable access and adoption of 5G technology in the agricultural sector.

In conclusion, 5G technology has the potential to reshape paddy farming and the broader agricultural landscape in Kedah. The demographic insights presented in this study emphasize the

need for inclusive and customized approaches to harness the full potential of 5G technology in agriculture, ensuring that its benefits reach farmers and stakeholders across diverse backgrounds and circumstances. As 5G technology continues to evolve, it offers a promising pathway to greater sustainability, efficiency, and prosperity within the agricultural industry.

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